APPENDIX B

UPDATED TIER 3 GROUND WATER EVALUATION

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UPDATED TIER 3 GROUND WATER EVALUATION

1.0 INTRODUCTION

ERM EnviroClean updated the Tier 3 contaminant transport modeling (originally presented in Addendum No. 2) to estimate the potential future contaminant concentrations in the ground water at the downgradient compliance points for the Aubrey site. Only the volatile organic compounds (VOCs) detected at concentrations above the Class I, Class II, and SWQC ground water standards in the past year of ground water monitoring (i.e., Third Quarter 1997 to Second Quarter 1998) were included in this evaluation. Specifically, ERM EnviroClean included: trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), 1,1-dichloroethene (1,1-DCE), and vinyl chloride in the Tier 3 contaminant transport modeling.

Railroad Creek is used as the downgradient compliance point for this evaluation. ERM EnviroClean believes the creek is the applicable compliance point because: (1) the ground water management zone (GMZ) for the site will likely extend to the creek, thereby requiring compliance with the 35 IAC 620 Class II standards in the lower water-bearing interval beneath the creek, and (2) the upper water-bearing interval discharges ground water to the creek, thereby requiring compliance with the surface water quality criteria (SWQC) at the point of discharge. The compliance criteria used for this evaluation are the SWQCs for the ground water in the upper water-bearing interval and the Class II standards for the ground water in the lower water-bearing interval.

ERM EnviroClean used the Second Quarter 1998 ground water monitoring well data to define source locations and concentrations for use in the model. These data were used in the model because they were obtained using standard sampling and analytical methodologies and they are the most current data. Each of the monitoring wells containing a VOC concentration exceeding the Class I, Class II, or SWQC standard was evaluated as a separate source area. The initial source concentration was based on the concentrations of chlorinated solvents detected in the well. For parent chlorinated solvents (TCE), the detected concentration was used as the initial source concentration. For daughter products (cis-1,2-DCE; 1,1-DCE; and vinyl chloride), ERM EnviroClean used the detected concentrations of the constituent plus the molar equivalent of the parent chlorinated solvent concentrations as the initial source concentration. This method is based on the conservative assumption that all of the TCE would degrade to cis-1,2-DCE and 1,1-DCE; and that all of the TCE; cis-1,2-DCE; and 1,1-DCE would degrade to vinyl chloride at the source with no attenuation.

The contaminant transport model uses a spatial regression technique to predict contaminant concentrations using site-specific data. Although ERM EnviroClean calculated site-specific degradation rates for the constituents exceeding the Class I standards in the upper water-bearing interval and the Class II standards in the lower water-bearing interval, the more conservative first-order decay rates from 35 IAC 742 were used in the model for both the upper and lower water-bearing interval simulations.

2.0 *UPPER WATER-BEARING INTERVAL SIMULATION*

ERM EnviroClean performed the predictive calculations for contaminant transport in the upper water-bearing interval using the site-specific, chemical-specific and default values summarized in Tables B-1 and B-2. Four upper interval wells (MW-8S, MW-9S, MW-13S and MW-18S) contained contaminant concentrations exceeding the Class I standards. As shown on Table B-3, simulations were performed for each of these wells.

The following calculations and data were used in the Tier 3 contaminant transport model:

- The change in concentration of a contaminant through time due to a first-order biological degradation.

$$C_t = C_o e^{-\lambda t}$$

- The time (t) needed for the ground water contaminant to travel from the source location to the compliance point.

$$t = d/V_c$$

- The distance (d) from the source (specific monitoring well) to the compliance point (Railroad Creek).

- The velocity of the ground water contaminant (V_c).

$$V_c = \frac{V_{gw}}{R}$$

- The velocity of the ground water (V_{gw}).

$$V_{gw} = \frac{Ki}{n}$$

- The retardation factor (R), which reflects the difference between the V_{gw} and V_c caused by the sorption of the contaminant onto the soil through which the ground water is moving.

$$R = 1 + \frac{\rho_b K_d}{n}$$

- The soil-water partition coefficient (K_d).

$$K_d = f_{oc} \cdot K_{oc}$$

The results of the predictive model indicate that no exceedances of the SWQC will occur in the stream as a result of transport of the contamination in the upper water-bearing interval from the source location to the compliance point (Table B-3).

3.0 LOWER WATER-BEARING INTERVAL SIMULATION

ERM EnviroClean performed the same predictive calculations for the contamination detected in the lower water-bearing interval as described above for the upper water-bearing interval to determine whether the applicable Class II standards will be exceeded at the compliance point. Two lower interval wells (MW-13D and MW-14) contained contaminant concentrations exceeding the Class II standards. As shown on Table B-3, simulations were performed for each of the constituents exceeding the Class II standards in these wells. The site-specific, chemical-specific, and default values used in the predictive calculations are summarized on Tables B-1 and B-2.

As shown on Table B-3, the calculations indicate that no exceedances of the Class II standards will occur in the lower interval ground water beneath the creek as a result of transport of the contamination detected in the lower interval monitoring wells.

TABLE B-1

SITE-SPECIFIC PARAMETERS USED IN TIER 3 EVALUATION
AUBREY MANUFACTURING, INC.
UNION, ILLINOIS

Parameter	Value	Rationale/Source
UPPER INTERVAL		
Source Location	Each upper interval well	Ground water plume likely has more than one source, approach is conservative and thorough.
Compliance Point	Intermittent stream	Upper interval ground water discharges to stream, which is the "effective" downgradient property line.
Compliance Criteria	Surface Water Quality Criteria (SWQC) for the stream	Ground water discharging to the stream must comply with the SWQC.
Horizontal Hydraulic Conductivity (K)	1.9 feet/day	Maximum horizontal hydraulic conductivity measured in the upper interval (CASRWPA2, Appendix D).
Horizontal Gradient (*i*)	0.019 feet/feet	Average gradient between former surface impoundment and stream based on June 1998 data.
Effective Porosity (n)	0.2	Maximum reported value for glacial sediments on Table C.3.2 of Wiedemeier et al. (1996).
Soil Bulk Density (ρ_b)	1.5 g/cm^3	Default value from 35IAC742, Appendix C, Table D.
Organic Carbon Content (f_{oc})	0.008 g/g	Average of results from samples taken from upper interval (CASRWPA2, Appendix C).
LOWER INTERVAL		
Source Location	Each lower interval well	Ground water plume likely has more than one source, approach is conservative and thorough.
Compliance Point	Intermittent stream	"Effective" downgradient property line.
Compliance Criteria	Class II Ground Water Standards	Must be protective of Class I standards at property line unless Class II is proven to be applicable
Horizontal Hydraulic Conductivity (K)	0.19 feet/day	Maximum horizontal hydraulic conductivity measured in the lower interval (CASRWPA2, Appendix D).
Horizontal Gradient (*i*)	0.017 feet/feet	Average gradient between former impoundment and stream based on June 1998 data.
Effective Porosity (n)	0.2	Maximum reported value for glacial sediments on Table C.3.2 of Wiedemeier et al. (1996).
Soil Bulk Density (ρ_b)	1.5 g/cm^3	Default value from 35IAC742, Appendix C, Table D.
Organic Carbon Content (f_{oc})	0.004 g/g	Average of results from samples taken from lower interval (CASRWP2, Appendix C).

TABLE B-2

CHEMICAL-SPECIFIC PARAMETERS USED IN TIER 3 EVALUATION
AUBREY MANUFACTURING, INC.
UNION, ILLINOIS

Parameter	Contaminant of Concern			
	Trichloroethene	1,1-Dichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
First Order Degradation Constant[1] (λ)(day^{-1})	0.00042	0.0053	0.00024	0.00024
Soil Adsorption Coefficient[1] (K_{oc}) (L/kg)	166	58.9	35.5	18.6
Molecular Weight (g/mol)	131	97	97	63

Note:

[1] The first order degradation constants and soil adsorption coefficients were obtained from 35 IAC 742, Appendix C, Table E.

TABLE B-3

SUMMARY OF TIER 3 PATHWAY EVALUATIONS
AUBREY MANUFACTURING, INC.
UNION, ILLINOIS

Source	Contaminant	Source Concentration[1]		Distance to Compliance Point	Calculated Concentration at Compliance Point	Compliance Criteria	
		Value	Rationale			Value	Rationale
Upper Interval							
MW-8S	Vinyl Chloride	16 ug/l	detected VC + molar equivalent of other detected parent chlorinated solvents	625 feet	2.8 ug/l	NS	SWQC
MW-9S	Vinyl Chloride	53 ug/l	detected VC + molar equivalent of other detected parent chlorinated solvents	595 feet	10 ug/l	NS	SWQC
MW-9S	Trichloroethene	71 ug/l	detected TCE	595 feet	0 ug/l	11,700 ug/l	SWQC
MW-9S	cis-1,2-dichloroethene	72 ug/l	detected cis + molar equivalent of TCE	595 feet	6.0 ug/l	NS	SWQC
MW-13S	1,1-dichloroethene	12 ug/l	detected DCE and molar equivalent of	419 feet	0 ug/l	3030 ug/l	SWQC
MW-18S	Vinyl Chloride	6 ug/l	detected VC + molar equivalent of other detected parent chlorinated solvents	25 feet	5.9 ug/l	NS	SWQC
MW-18S	Trichloroethene	5 ug/l	detected TCE	25 feet	2.6 ug/l	11,700 ug/l	SWQC
Lower Interval							
MW-13D	Trichloroethene	230 ug/l	detected TCE	419 feet	0 ug/l	25 ug/l	Class II
MW-13D	cis-1,2-Dichloroethene	720 ug/l	detected cis + molar equivalent of TCE	419 feet	0.002 ug/l	200 ug/l	Class II
MW-13D	Vinyl Chloride	570 ug/l	detected VC + molar equivalent of other detected parent chlorinated solvents	419 feet	0.03 ug/l	10 ug/l	Class II
MW-14	Trichloroethene	100 ug/l	detected TCE	285 feet	0 ug/l	25 ug/l	Class II
MW-14	Vinyl Chloride	54 ug/l	detected VC + molar equivalent of other detected parent chlorinated solvents	285 feet	0.07 ug/l	25 ug/l	Class II

Key:

TCE = Trichloroethene
VC = Vinyl Chloride
SWQC = Surface Water Quality Criteria
NS = No SWQC data available

Notes:

[1] Source concentrations based on data from Second Quarter 1998 Ground Water Monitoring Report.

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FINAL REPORT

ENVIRONMENTAL RESOURCES MANAGEMENT GROUP

Aubrey Manufacturing, Inc.

Corrective Action Status Report and Work Plan Addendum No. 1

February 20, 1997

Project No. 2060

ERM-EnviroClean-North Central, Inc.
611 East Wisconsin Avenue, Suite 560
Milwaukee, Wisconsin 53202

ERM®

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1.0 *INTRODUCTION*

This Corrective Action Status Report and Work Plan Addendum No. 1 presents:

- The results of the ground water screening activities performed pursuant to Task 1 of the Corrective Action Work Plan (the "Work Plan") to investigate the downgradient extent of the ground water plume;

- The proposed locations of monitoring wells to be installed along the downgradient margin of the ground water plume pursuant to Work Plan Task 2;

- The proposed scope of a hot spot investigation to be performed as Work Plan Task 6; and

- The proposed conceptual plan for implementing a remediation system to address the ground water plume and soil hot spots, if any, as Work Plan Task 7.

The Work Plan (ERM-EnviroClean, 1996a) is a modification to the approved Closure Plan (ERM-EnviroClean, 1993) for the former surface impoundment at the Aubrey Manufacturing, Inc. (Aubrey) facility in Union, Illinois (Figure 1). The Illinois Environmental Protection Agency (IEPA) approved the Work Plan with the conditions and modifications detailed in letters to Aubrey dated July 2, 1996 and November 8, 1996. ERM-EnviroClean-North Central, Inc. (ERM-EnviroClean) was retained by Aubrey to implement the approved Work Plan and design a remediation system to address the ground water plume and soil hot spots, if any.

2.0 STATUS REPORT

2.1 DESCRIPTION OF WORK PERFORMED

Task 1 of the Work Plan consisted of screening the ground water beneath the property immediately to the east of the Aubrey site to determine the downgradient extent of the ground water plume. ERM-EnviroClean and its subcontractor, On-Site Environmental Services, Inc. of DeForest, Wisconsin, advanced and sampled seven GeoProbe borings (SB-1 through SB-7) in the easement on the east side of Main Street on July 1, 1996 (Figure 2). Twelve additional GeoProbe borings (SB-8 through SB-16, SB-8A, SB-11D, and SB-13D) were advanced in the agricultural field to the east of Main Street on August 26 and August 27, 1996 (Figure 2).

The ground water screening activities were generally conducted in conformance with the procedures outlined in Section 3.1.1 of the Work Plan. The only deviations from the approved Work Plan are summarized below:

- The soil sampling devices were 1.5 inches in diameter instead of 1 inch in diameter.

- Four soil borings (SB-10, SB-13D, SB-14, and SB-15) were advanced beyond the upper water-bearing interval to evaluate the deeper water-bearing intervals because the field analytical data showed no contamination in the upper water-bearing interval at those locations or the upper water-bearing interval did not produce water at those locations.

- Soil samples were not collected and analyzed for grain size, Atterberg limits, and total organic carbon. These sampling activities will be performed during the monitoring well installation activities (Work Plan Task 2).

- Three surface water samples (SS-1, SN-1, and ISS-1) were collected from the intermittent stream at the locations shown on Figure 2 and analyzed in the field for volatile organic compounds (VOCs). The samples were not submitted for laboratory analysis.

- The borings yielded an insufficient quantity of ground water to allow field parameter measurements, field VOC analysis, and laboratory VOC analysis. Therefore, ERM-EnviroClean did not perform the field parameter measurements which would have included pH, conductivity, and temperature measurements.

- The laboratory analysis of the ground water samples were performed using U.S. Environmental Protection Agency (USEPA) SW-846 Method 8240 rather than Method 8260.

These deviations from the approved Work Plan do not adversely affect, and in some instances improve, the quality or quantity of the data needed to define the downgradient extent of the ground water plume.

2.2 *HYDROGEOLOGIC DATA AND INTERPRETATION*

The hydrogeologic data obtained during the ground water screening activities include descriptions of the soils encountered in the GeoProbe borings and along the banks of the intermittent stream and the approximate elevations of the ground water encountered in the Geoprobe borings and at the seeps along the intermittent stream. Copies of the geologic logs for the GeoProbe borings and the intermittent stream section are included as Appendix A.

As discussed in the Ground Water Investigation Report (ERM-EnviroClean, 1995), the only aquifer potentially affected by the ground water plume is the Prairie Aquigroup, which in the site area, is limited to the sand and gravel deposits of the Henry Formation. The deeper aquifers (i.e., the Upper Bedrock and Midwest Bedrock Aquigroups) are separated from the ground water plume by more than 30 feet of low permeability glacial till deposits that protect them from the downward migration of contaminants. Therefore, this investigation focused on the Henry Formation and the glacial till deposits of the laterally equivalent Tiskilwa Member of the Wedron Formation.

The GeoProbe borings advanced on the property to the east of the Aubrey property encountered a thick sand and gravel deposit that was not encountered beneath the Aubrey property. As illustrated on Figure 3, the sand and gravel deposit is up to 8.5 feet thick, extends to the east beyond the intermittent stream, and pinches out in the sandy silty clay till of the Tiskilwa Member to the north, south and west. It is underlain by the clay till deposits of the Tiskilwa Member and overlain by approximately 2 feet of loamy topsoil (Figure 3).

Based on its lithology and stratigraphic position, the sand and gravel deposit appears to be an extension of the Henry Formation, which is a thick glacial outwash deposit composed of sand and gravel. The main body of the Henry Formation is situated to the east of the Aubrey property, in a paleovalley underlying the Kishwaukee River valley. According to Willman and Frye, (1970), the sands and gravels of the Henry Formation were deposited in valleys carved into the underlying glacial till and bedrock by rivers that formed during retreat of the Late Pleistocene glacial ice sheet.

During the ground water screening activities, ground water was encountered in: (1) the sand and gravel deposits of the Henry Formation, and (2) the thin silt, sand, and/or gravel beds that occur within the sandy, silty clay of the Tiskilwa Member. As shown on Figure 3, some of the thin silt, sand, and/or gravel beds in the Tiskilwa Member are probably interconnected with the sand and gravel of the Henry Formation, forming a laterally continuous water-bearing unit. However, isolated lenses of water-bearing silt, sand, and/or gravel also occur in the shallow and deep portions of the Tiskilwa Member (Figure 3).

The ground water in the thin silt, sand, and/or gravel beds within the Tiskilwa Member is confined, whereas the ground water in the sand and gravel deposits of the Henry Formation is unconfined. The confined conditions are evident from static water levels that are higher than the tops of the silt, sand, and/or gravel beds (Figure 3). The unconfined conditions are indicated by static water levels within the sand and gravel deposits (Figure 3).

Static water level measurements obtained from the shallow monitoring wells at the site and from a seep in the bank of the intermittent stream indicate that the ground water flow direction in the upper water-bearing interval (including the sand and gravel deposit in the Henry Formation) is toward the east, and the average horizontal gradient is approximately 0.02 feet/feet. As illustrated on Figure 3 and evidenced by ground water seeping from the banks of the intermittent stream, the ground water in the upper portion of the sand and gravel deposits discharges to the intermittent stream. Drain tiles visible along the eastern bank of the intermittent stream likely enhance the discharge of ground water to the stream from the agricultural field to the east of the stream. Based on static water level measurements taken from the deep monitoring wells on the site, ground water flow in the lower-water bearing interval is toward the northeast with an average horizontal gradient of 0.02 feet/feet. A comparison of the static water level measurements taken in the upper- and lower-water bearing units shows a consistent downward flow gradient of 0.09 to 0.36 feet/feet.

Specific aquifer parameters such as hydraulic conductivity, grain size, and total organic carbon for the Tiskilwa Member are detailed in the Ground Water Investigation Report (ERM-EnviroClean, 1995) and will be determined for the sand and gravel deposits of the Henry Formation during installation of the off-site monitoring wells (Task 2). The ground water flow direction and gradients in the sand and gravel deposits of the Henry Formation will also be confirmed during Task 2.

2.3 GROUND WATER PLUME DATA AND INTERPRETATION

The chemical data obtained during the ground water screening activities includes the results of:

- Real time, screening-level, analyses performed in the field to guide the collection of a sufficient number of ground water samples to define the downgradient extent of the ground water plume, and

- Laboratory analyses performed under controlled conditions and using USEPA methodologies to verify the downgradient extent of the ground water plume.

The results of the field and laboratory analyses are summarized on Tables 1 and 2, respectively; and copies of the field and laboratory analytical reports are included as Appendices B and C, respectively. Although the field analyses provide data that are less accurate, precise, and complete than the laboratory data, the results of the field analyses correlate reasonably well with the results of the laboratory analyses, and proved to be a reliable indicator of ground water concentrations exceeding the Class I ground water standards presented in 35 IAC 620.410 (the "Class I Standards"). The results of the field analyses were used on a real-time basis to guide the placement of sufficient GeoProbe borings to define the approximate extent of the off-site portion of the ground water plume. However, the description of the nature and extent of the off-site portion of the ground water plume presented in this document is based solely on the results of the laboratory analysis.

Ground water samples were obtained from 18 GeoProbe boring locations (SB-1 through SB-16, SB-8A, and SB-13D) and analyzed for VOCs by IEA of Schaumburg, Illinois. Fourteen of the ground water samples (i.e., SB-1W through SB-7W, SB-8, SB-8A, SB-9, SB-11, SB-12, SB-13, and SB-16) were collected from the upper water bearing interval, and all but two of these samples (i.e., SB-2W and SB-5W) were obtained from the sand and gravel deposit of the Henry Formation. The other four samples (i.e., SB-10, SB-13D, SB-14, and SB-15) were collected from thin silt, sand, and/or gravel beds in the lower water-bearing interval of the Tiskilwa Member.

As shown on Table 2, nine ground water samples from the upper water-bearing interval (i.e., SB-1W through SB-4W, SB-6W, SB-8, SB-8A, SB-9, and SB-12) and one sample from the lower water-bearing interval (i.e., SB-10) contained detectable concentrations of VOCs. Seven of the upper water-bearing interval samples (SB-1W through SB-4W, SB-6W, SB-8, and SB-8A) and one of the lower water-bearing interval samples (SB-10) contained VOC concentrations exceeding the Class I Standards. The VOCs detected in the ground water samples include 1,1-dichloroethene

(1,1-DCE); 1,1-dichloroethane (1,1-DCA); cis-1,2-dichloroethene (cis-1,2-DCE); 1,1,1-trichloroethane (TCA); trichloroethene (TCE); vinyl chloride; chloroethane; toluene; and acetone[1] (Table 2).

ERM-EnviroClean evaluated the nature and extent of the entire ground water plume by assessing the VOC data from the off-site GeoProbe boring samples (Table 2) in combination with the data from the most recent (i.e., first quarter 1996) on-site monitoring well samples (Table 3). As illustrated on Figure 4, the horizontal extent of the ground water plume can be fully delineated using these data because ground water samples achieving Class I Standards were collected from monitoring wells and/or GeoProbe borings situated upgradient (MW-5 and MW-6), sidegradient (MW-10, MW-11, MW-12, MW-16, SB-5 and SB-7), and downgradient (SB-9, SB-11/11D, SB-12, SB-13/13D, SB-14, SB-15, and SB-16) of the plume. The ground water plume extends from the former surface improvement approximately 650 feet downgradient, where it extends approximately 90 feet onto the neighboring property (Figure 4). The ground water plume fans out in the downgradient direction from less than 100 feet wide at the former surface improvement to a maximum width of approximately 450 feet at the eastern boundary of the Aubrey property (Figure 4).

On the Aubrey property, the ground water plume occurs in thin silt, sand, and/or gravel seams within the Tiskilwa Member till, whereas on the property immediately to the east of the Aubrey property, the ground water plume occurs primarily in the sand and gravel deposit of the Henry Formation. The transition between the thin seams of silt, sand and/or gravel and the thicker sand and gravel deposits occurs along Aubrey's eastern property boundary. The ground water plume encompasses much of the upper water-bearing interval [i.e., 835 to 855 feet above mean sea level (AMSL)] and a few isolated areas within the lower water-bearing interval (i.e., 820 to 835 feet AMSL). Soil borings advanced beyond the lower water-bearing interval either encountered no ground water or thin seams of silt containing clean ground water. On the basis of these data, the maximum depth of the ground water plume is 35 feet BGS (approximately 820 feet AMSL). However, most of the ground water plume is less than 20 feet BGS (i.e., 835 AMSL).

The distribution of constituents and the trends in constituent concentrations within the ground water plume are irregular and complex. Specifically, the ground water in the upgradient portion of the plume (i.e., near the former surface improvement) contains vinyl chloride at concentrations ranging from <1 to 41 ug/l and no other chlorinated solvents, whereas the ground water in the middle portion of the plume (i.e., on the east side of the Aubrey property) contains TCE; TCA; cis-1,2-DCE; 1,1-DCA; 1,1-DCE, and vinyl chloride at concentrations ranging from <1 to 600 ug/l (Table 3). The downgradient (off-site) portion of the plume contains TCE; TCA; cis-1,2-DCE; 1,1-DCA; 1,1-DCE and vinyl chloride at concentrations ranging from <5 to 210 ug/l (Table 2). The trends in total chlorinated solvent concentrations and parent to degradation product ratios indicate that the ground water plume probably resulted from more than one source (i.e., the former surface improvement and other unconfirmed sources at the Aubrey site) perhaps of varying ages. As such, the ground water plume may consist of several smaller overlapping plumes rather than a single continuous plume.

2.4 *SURFACE WATER DATA AND INTERPRETATION*

ERM-EnviroClean collected three surface water samples (ISS-1, SS-1, and SN-1) from the intermittent stream and On-Site Environmental analyzed them for VOCs using the same real time screening level analyses performed on the ground water samples. The surface water samples were collected and analyzed to determine whether the ground water plume was discharging to the intermittent stream and affecting the surface water quality.

The results of the field analyses are summarized on Table 4, and included on the analytical report in Appendix B. As shown on Table 4, none of the samples contained detectable constituent concentrations. These results indicate that the ground water plume is either not discharging to the stream or discharging constituent concentrations too low to show a detectable impact to the stream water.

3.0 WORK PLAN ADDENDUM

This addendum describes modifications to the tasks presented in the Work Plan as well as additional investigation and/or remediation tasks to be performed at the site for the closure of the former surface improvement. The modified and/or additional Work Plan tasks include:

- Task 2: Monitoring Well Installation;
- Task 6: Hot Spot Investigation, and
- Task 7: Remediation System Design and Implementation.

Pending approval from the IEPA, this addendum will become part of the Closure Plan for the former surface improvement.

3.1 TASK 2: MONITORING WELL INSTALLATION

Section 3.2 of the Work Plan states that three to five upper and lower water-bearing interval monitoring wells will be installed to define the downgradient extent of the ground water plume, and that the locations of the wells will be selected based on the results of the ground water screening and attenuation modeling. ERM-EnviroClean proposes to install four off-site monitoring wells (i.e., MW-17S, MW-17D, MD-18S, and MW-18D) at the locations shown on Figure 5 to define the downgradient extent of the plume. The two shallow (MW-17S and MW-18S) and two deep (MW-17D and MW-18D) monitoring wells will be constructed with screens set in the upper and lower water-bearing intervals, respectively. The wells will be located slightly beyond the downgradient extent of the ground water plume (as defined by the ground water screening data) to allow for plume migration since perfomance of the ground water screening. Additionally, the well locations are situated as close to the intermittent stream as practicable to minimize any inconveniences that may affect the property owner's ability to perform agricultural activities on the property.

The drilling, construction, development, and hydraulic conductivity testing of the wells will be performed in accordance with the procedures described in Section 3.2 of the Work Plan. Additionally, two soil samples will be obtained from each monitoring well cluster location for analysis of grain size, Atterberg limits, and total organic carbon. The samples will be collected and analyzed as described in Section 3.1.1 of the Work Plan. These samples were originally planned for collection as part of Task 1, the GeoProbe ground water screening activities. Concrete-filled steel posts will be installed in a triangular arrangement around each well cluster to protect the wells from being damaged by farm machinery.

The ground water monitoring activities performed pursuant to Section 3.3 of the Work Plan will be resumed upon completing the installation and development of the off-site monitoring wells. The ground water sampling and analyses will be performed in accordance with the requirements stated in the IEPA's April 16, 1996 letter outlining specific ground water monitoring requirements for the project. Ground water monitoring activities were suspended at the site in June 1996 pending the delineation of the downgradient extent of the ground water plume and installation of the off-site monitoring wells. This action was verbally approved by the IEPA in June 1996 and confirmed in a June 21, 1996 letter to the IEPA from ERM-EnviroClean.

The data from the ground water monitoring well installation testing and sampling will be recorded on geologic drill logs, field logs, and analytical reports from the laboratory. ERM-EnviroClean will use the stratigraphic and hydrogeologic data from the monitoring wells to modify the geologic cross-sections and piezometric surface maps of the site. The analytical data will be tabulated and plotted on maps and cross-sections to define the horizontal and vertical extent of the ground water plume. This information will be used to define the boundaries of the ground water management zone. The results of Task 2 will be summarized in Corrective Action Status Report and Work Plan Addendum No. 2, which will be transmitted to the IEPA for review and approval.

3.2 *TASK 6: HOT SPOT INVESTIGATION*

A hot spot investigation will be performed within the ground water plume on the Aubrey property to determine:

- The locations, magnitude, and extent of any hot spots in the unsaturated soil overlying the ground water plume;
- The constituent concentrations in the central portion of the ground water plume; and
- The location, size, and thickness of on-site soils having hydrogeologic characteristics suitable for *in situ* remediation activities.

The investigation activities will consist of advancing 15 initial GeoProbe borings at the locations shown on Figure 6 and additional GeoProbe borings as needed to define the extent of any identified hot spots. The locations of the initial set of GeoProbe borings were selected based upon an evaluation of the historical operations at the facility and gaps in the existing hydrogeologic and ground water plume data. With the assistance of Aubrey personnel, ERM-EnviroClean identified the locations of the historical operations at the facility that are or were potential sources of chlorinated solvents. The specific locations to be evaluated include:

- The waste water treatment area;
- The chemical storage area;
- The former drainage ditch associated with the former surface improvement;
- The former vapor degreasing area;
- The former plating waste holding tank area;
- The former septic leach field area;
- The former plating area;
- The backfill around the fire suppression water storage tank;
- The backfill around the sewage holding tank;
- The backfill around the cooling water, septic, and stormwater piping; and
- The waste chemical storage area.

Although no releases of chlorinated solvents are known to have occurred from any of these locations, ERM-EnviroClean will advance 10 GeoProbe borings near these locations and will test the soil and ground water at each location to determine whether a hot spot exists. The rationale for each GeoProbe location is summarized on Table 5. Five of the GeoProbe borings (SB-27 through SB-31) will be advanced along Aubrey's eastern property boundary to evaluate the thickness, extent, continuity, grain size, and ground water constituent concentrations of the western portions of the sand and gravel deposit of the Henry Formation. The existing data indicate that the sand and gravel deposit has hydrogeologic characteristics suitable for *in situ* soil and/or ground water remediation system. However, optimization of the remediation system design requires understanding the spatial distribution of the sand and gravel deposit relative to the soil and/or ground water hot spots on the Aubrey property. The stratigraphic and constituent concentration data from these five GeoProbe borings will satisfy this data requirement. Lastly, the constituent concentration data for all of the ground water samples collected from the GeoProbe borings will assist in better defining the distribution and magnitude of constituents within the ground water plume.

3.2.1 *GeoProbe Boring Advancement and Sampling*

A GeoProbe drilling unit will be used to advance and sample each soil boring to the bottom of the upper water-bearing interval (i.e., 10 to 20 feet BGS). Because all of the GeoProbe borings will be advanced within the ground water plume, the upper water-bearing interval is assumed to be contaminated. As such, the GeoProbe borings will not be advanced beyond the upper water-bearing interval unless no ground water is encountered in the upper interval and the lower water-bearing interval can be tested without the possibility of cross-contamination. The borings will be advanced using a nominal 1.5-inch diameter probe and soil samplers will be collected continuously using either 2-foot or 4-foot long split-spoon samplers. The following procedures will be used to log, field screen, and sample the soils encountered in each GeoProbe boring:

- Each sample interval will be logged by an ERM-EnviroClean geologist by describing the length, color, density, grain size, sorting, composition, structure, and moisture content of the soil sample from visual observation. The density of the soil will be determined by using a pocket penetrometer, and the color of the soil will be identified by comparison with a rock color chart. The geologic description and screening results for each sample interval will be recorded in a field log book.

- A portion of each 2-foot sample interval collected above the water table will be immediately placed in appropriate sample bottles supplied by the on-site laboratory and the bottles will be placed on ice in a cooler.

- Another portion of each 2-foot sample will be placed in a glass jar for field screening of VOCs with a photoionization detector (PID). The jar will be filled approximately ⅓ full, capped, and briefly agitated. After allowing the jar to sit for several minutes, a PID equipped with an 11.7 eV lamp will be inserted into the headspace above the soil to obtain a total VOC reading. The reading will be recorded in the field log book.

- After the GeoProbe has been advanced to the bottom of the upper water-bearing interval, the ERM-EnviroClean geologist will review and select the most permeable two-foot interval of water-saturated soil for collection of a ground water sample. The GeoProbe operator will position the probe at the selected sample interval and deploy a small-diameter screen point. The ERM-EnviroClean geologist will record the time and interval of each ground water sample in the field log book.

- Ground water will be extracted by placing inert tubing into the sampler and pumping the ground water with a peristaltic pump.

- A minimum of three screened interval volumes will be purged with the pump and placed in 5-gallon plastic pails. Purge water will be transferred to 55-gallon drums approved by the U.S. Department of Transportation (DOT) and stored pending laboratory analysis and appropriate disposal.

- Ground water samples will be collected from the pump discharge and placed in appropriate laboratory-supplied bottles. Approximately five VOC vials will be filled for each general water sample to ensure the collection of sufficient volume for on-site laboratory analysis and confirmatory off-site laboratory analysis. The bottles will be placed on ice in a cooler.

- Upon completion, each soil boring will be abandoned in accordance with the requirements of IAC 620.120, and the location and surface elevation of each boring will be determined by a State-of-Illinois licensed surveyor.

- All drill cuttings will be placed into DOT-approved steel drums and stored on the property pending laboratory analysis and appropriate disposal.

- All drilling equipment will be decontaminated before beginning drilling, between borings, and prior to demobilization in accordance with procedures established in the site Health and Safety Plan. Sampling equipment will be decontaminated and new sampling gloves will be donned between each sample in accordance with the site Health and Safety Plan.

3.2.2 *Sample Selection and Analysis*

The ERM-EnviroClean geologist will transmit one ground water sample and up to two soil samples for each GeoProbe boring to a portable on-site laboratory for analysis of selected VOCs. Only one ground water sample will be collected for each GeoProbe boring; however, several unsaturated soil samples will be collected for possible VOC analysis. The ERM-EnviroClean geologist will review the field screening results for the unsaturated soil samples and select samples for on-site analysis based upon the following criteria:

- If the field screening results show no evidence of a release (i.e., no stained soil, headspace readings less than 5 Vppm above background and no obvious ~~colors~~ odors) than one soil sample will be obtained from the interval most likely to be contaminated in that boring (i.e., the uppermost interval for borings associated with aboveground operations and the interval underlying the subject structure for borings associated with subsurface operations) and will be transmitted to the on-site laboratory for analysis.

- If the field screening results show evidence of a release, then two soil samples (i.e., the one exhibiting the highest level of contamination and the first "clean" sample from beneath the contaminated sample) will be transmitted to the on-site laboratory for analysis.

- If the field screening results from borings SB-27 through SB-31 show no evidence of a release in the unsaturated soil, no soil samples from these borings will be transmitted for VOC analysis.

The on-site laboratory will analyze the ground water and selected soil samples using a field gas chromatograph and methodologies modified from the U.S. Environmental Protection Agency's (USEPA's) SW-846 Methods 8010, 8020, and 3810. The analyses will provide quantitative concentration data for the chlorinated solvents TCE, TCA, vinyl chloride, and tetrachloroethene; and qualitative data for other VOCs. ERM-EnviroClean will: (1) determine the need for and location of additional GeoProbe borings, and (2) select locations for collecting soil samples for confirmatory laboratory analysis based upon the daily evaluation of the results of the on-site laboratory analysis. If the on-site laboratory analyses indicate the presence of a hot spot in the unsaturated soil, ERM-EnviroClean will advance additional GeoProbe borings to define the extent of the hot spot and collect confirmatory soil samples using the Attachment 7 methodology described in the Closure Plan (ERM-EnviroClean, 1993). The confirmatory soil samples will be analyzed at an off-site laboratory using standard USEPA methodologies.

All of the ground water samples and selected unsaturated soil samples will be transmitted to IEA for analysis of VOCs using USEPA's SW-846 Method 8240. These samples will be preserved, labeled, and transported using standard sample handling protocol, and chain-of-custody procedures. Unsaturated soil samples will only be submitted for confirmatory laboratory analysis if the results of the field laboratory analysis show the presence of a hot spot in the unsaturated soil. ERM-EnviroClean will select the number and locations of unsaturated soil samples to be analyzed such that the magnitude and vertical and horizontal extent of the soil hot spot(s) can be determined from the results of the confirmatory analyses.

3.2.3 *Data Summary and Interpretation*

The data from the hot spot investigation will be recorded on geologic drill logs, and analytical reports from the on-site and off-site laboratories. ERM-EnviroClean will use the stratigraphic and hydrogeologic data from the GeoProbe borings to modify and enhance the detail of the existing geologic cross-sections of the site (Figure 3). The analytical data will be tabulated and the confirmatory analytical data will be plotted on maps and cross-sections of the site to assist in assessing:

- The location, magnitude, and extent of any hot spots in the unsaturated soil;
- The magnitude and spatial distribution of the ground water plume constituents; and

- The areas of the site having hydrogeologic conditions suitable for *in situ* remediation activities.

The results of the hot spot investigation will be summarized in Corrective Action Status Report and Work Plan Addendum No. 2.

3.3 *TASK 7: REMEDIATION SYSTEM DESIGN AND IMPLEMENTATION*

A remediation system will be designed and implemented to address the ground water and unsaturated soil hot spots having hydrogeoloigic conditions suitable for *in situ* remediation of the affected media.

The objectives of the proposed remediation system are to:

- Reduce the constituent concentrations in the off-site portion of the ground water plume to levels achieving Class I standards as expeditiously as technically and economically feasible,

- Minimize the amount of monitoring equipment installed on the neighboring property,

- Complete the remediation of the off-site ground water and remove all monitoring equipment from the neighboring property within 2 years of starting the remediation system,

- Reduce the constituent concentrations in the on-site portion of the ground water plume to levels that achieve site-specific (Tier 2) ground water remediation objectives that are protective of the off-site Class I ground water.

- Reduce the constituent concentrations in the unsaturated soil hot spots having hydrogeologic conditions conducive to *in situ* remediation, if any, to levels that achieve site-specific (Tier 2) soil remediation objectives.

- Complete the remediation of the on-site soil and ground water as soon as technically and economically feasible,

- Minimize the usage of permanent engineered barriers and/or a long-term active remediation systems, and

- Utilize natural attenuation processes to the extent practicable to achieve the soil and ground water remediation objectives, particularly in areas of the site that are not suitable for active remediation.

ERM-EnviroClean performed a preliminary evaluation of several remediation systems suitable for the site conditions and reviewed the options with Aubrey. Aubrey has preliminarily selected a conceptual remediation system design consisting of: (1) an on-site ground water sparging system situated along Aubrey's eastern property boundary, and (2) supplemental on-site soil vapor extraction and ground water sparging systems to address hot spots having suitable hydrogeologic conditions. After the results of the hot spot investigation and next round of ground water monitoring well samples are available, the conceptual remediation system design will be reviewed and revised as necessary to ensure implementation of a system that is technically and economically feasible.

The current conceptual plan is to install sparging wells along Aubrey's eastern property boundary, in areas where the sand and gravel deposit of the Henry Formation extend onto the Aubrey property. The sparging system would intercept the ground water plume prior to its migration off-site, thereby cutting off the source of the off-site portion of the water plume. Preliminary modeling of the fate and transport of the ground water plume constituents indicates that the constituent concentrations in the off-site portion of the ground water plume would decrease by natural attenuation to levels below the Class I standards within approximately one year of intercepting the on-site portion of the plume.

Supplemental soil vapor extraction and ground water sparging systems would be installed on the Aubrey site to address hot spots having suitable hydrogeologic conditions. The purpose of these systems would be to quickly and efficiently address the areas of the site containing the highest constituent concentrations. Based on the existing site data, ERM-EnviroClean suspects that the backfill around the sewage holding tank and fire suppression water tank may contain elevated constituent concentrations and have hydrogeologic conditions suitable for remediation using soil vapor extraction and/or ground water sparging. This area as well as other potential hot spot areas will be evaluated as part of the hot spot investigation, and the technical and economic feasibility of addressing the hot spots using the selected *in situ* remediation techniques will be reassessed using the additional data.

If the results of the hot spot investigation indicate that the selected remediation system is not technically and/or economically feasible, ERM-EnviroClean will evaluate alternative remedial technologies such as *in situ* oxidation, dual-phase vacuum extraction, ground water pump and treat, and physical or hydraulic barriers. If the hot spot investigation data confirm the feasibility of the selected remediation system, ERM-EnviroClean will prepare a detailed design for the selected system. The system design will include technical specifications, design drawings, permit requirements, operation and maintenance procedures, and other design details. The design will be summarized in Corrective Action Status Report and Work Plan Addendum No. 2.

4.0 *PROJECT SCHEDULE*

The low risk to human health and the environment posed by the current site conditions allows the corrective action to proceed as a non-emergency activity. However, Aubrey is committed to implementing the corrective action in an environmentally sound and cost-effective manner that is sensitive to the wishes of the neighboring property owners. As indicated on the project schedule included as Figure 7, Aubrey plans to install the off-site monitoring wells (Task 2), collect the 1st Quarter 1997 monitoring well samples (Task 3), and perform the hot spot investigation (Task 6) by the end of March 1997. Completion of Tasks 2 and 3 is, however, contingent upon receiving authorization from the owner of the neighboring property to install and sample the off-site monitoring wells. Design of the remediation system is scheduled for April 1997, with system construction planned for May and June 1997. Startup of the remediation system is scheduled for June 23, 1997. Corrective Action Status Report and Work Plan Addendum No. 2 (which will describe the results of Tasks 2, 3, and 6, and present the design of the remediation system) will be transmitted to the IEPA in May 1997 for review and approval.

The schedule for design and installation of the remediation system may be revised depending upon the complexity of the remediation system; availability of equipment and construction contractors; permitting requirements and approval times; and need for and timeliness of approvals from the Village of Union, neighboring property owners, and the IEPA. An updated schedule for implementing the remediation system, including the schedule for operating, monitoring, and shutting down the remediation system will be included in Corrective Action Status Report and Work Plan Addendum No. 2.

Based on preliminary modeling results and professional judgment, we anticipate that the off-site portion of the ground water plume will dissipate via natural attenuation within approximately 1 year of starting up the remediation system. We anticipate removing all remediation and monitoring equipment from the neighboring property and redefining the ground water management zone such that it no longer includes the off-site property within 2 years of starting up the remediation system.